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Forest Pest Management Report

R-3 85-4

BIOLOGICAL EVALUATION
Western Spruce Budworm

Santa Fe National Forest, Jemez Indian Pueblo,
and Santa Clara Indian Pueblo
New Mexico

December 1984

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USDA Forest Service, Southwestern Region
State and Private Forestry
Forest Pest Management
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INTRODUCTION

The western spruce budworm, Choristoneura occidentalis Free., continued to defoliate mixed conifer stands on the Santa Fe National Forest, Jemez Indian Pueblo, Santa Clara Indian Reservation, and Bandelier National Monument in 1984. This current outbreak was initially detected in 1976 when aerially visible defoliation was observed on the Jemez East and Jemez West entomological units. In subsequent years, defoliation expanded to include most of the mixed conifer type in the Jemez Mountains. In 1983, defoliation was observed in the Mesas entomological unit for the first time. In 1984, defoliation was observed, for the first time, on the Pecos and Tesuque entomological units.

The Santa Fe National Forest issued a Draft Environmental Impact Statement (DEIS), Western Spruce Budworm Management Program, Santa Fe National Forest, on April 29, 1983. An analysis of the budworm situation and alternative management actions are discussed in this document. While the DEIS analyzes, develops, and documents a budworm management program for the Santa Fe National Forest, this biological evaluation report represents a continuing budworm monitoring effort by Forest Pest Management and the Santa Fe National Forest supporting the proposed budworm management program.

Forest Pest Management conducted egg mass surveys on eight entomological units during August and September 1984. The purpose of these surveys was to estimate current egg mass densities and predict defoliation levels in 1985. Results and recommendations are presented.

TECHNICAL INFORMATION

Insect. Western spruce budworm, Choristoneura occidentalis Freeman

Hosts. Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco
White fir, Abies concolor (Gord. & Glend.) Lindl.
Subalpine fir, Abies lasiocarpa (Hook.) Nutt.
Blue spruce, Picea pungens Engelm.
Engelmann spruce, Picea engelmannii Parry

Life History. The western spruce budworm completes one generation each year (Furniss and Carolin 1977).

Stage	Time	Location on host
Egg	August	On needles
Small larvae	Overwinter	In hibernaculum (silken cocoons) on branches and trunk
Large larvae	June	On buds and strobile
Pupae	July	On foliage
Adults	August	In flight

Evidence of Infestation

1. Young larvae feeding on newly expanding buds and strobile.

2. Mature larvae consuming current year's needles.

3. Shoots webbed together by larvae.

4. Webbed shoots turning brown.

5. Defoliation most evident in upper crowns of trees.

6. Trees dying from the top downward after several years of heavy defoliation.

Extent of Defoliation in 1984. Aerially detected defoliation on the Santa Fe National Forest, Bandelier National Monument, Jemez Indian Pueblo, and Santa Clara Indian Reservation was estimated at 266,475 acres. Figures 1 through 7 illustrate defoliated acreage. Table 1 presents defoliation by reporting unit and severity.

In addition to the acreage on Federal and Federal trust lands, 17,272 acres were reported defoliated on the Baca Location No. 1.

BIOLOGICAL INFORMATION

Methods. Egg mass surveys were conducted in August and September to estimate egg mass densities. Two branches (45 cm in length) were cut from opposite sides of the midcrown of three sample trees on plots located in each sampling area. Sample trees met the following criteria: Douglas-fir, dominant or codominant; 30 to 50 feet in height; relatively open grown with a full crown; and some budworm feeding evident, but not severely defoliated or top-killed. Each branch was individually bagged in cloth sacks, tied securely, labeled, and transported to a laboratory for examination. Foliage was stored in a walk-in cooler at about 40° F until examined.

In the laboratory, foliage was examined under ultraviolet light for egg masses. Needles with egg masses were classed as from current year's foliage or a previous year's foliage and kept separate in labeled pill boxes. New and old egg masses were separated by an experienced laboratory technician. All egg masses on current year's foliage were classed as new and their characteristics formed the basis for aging egg masses found on previous year's foliage.

TABLE 1.--Aerially observed defoliation in 1984

Unit	Defoliation			
	Light	Moderate	Heavy	Total
Coyote RD	20,150	31,925	6,875	58,950
Cuba RD	8,525	68,750	5,775	83,050
Jemez RD	12,725	28,925	11,850	53,500
Espanola RD	8,325	17,350	25,775	51,450
Pecos RD	2,750	0	0	2,750
Tesuque RD	1,950	0	0	1,950
Subtotal Santa Fe NF	54,425	146,950	50,275	251,650
Bandelier National Monument	800	700	2,825	4,325
Jemez Indian Pueblo	250	825	425	1,500
Santa Clara Reservation	1,350	5,975	1,675	9,000
Total	56,825	154,450	55,200	266,475

Defoliation estimates for 1985 are predicted from current egg mass densities. These predictions are derived from the following egg mass density categories developed by McKnight et al. (1970):

Egg mass density[a]	Predicted defoliation class[b]
1.55	Undetectable for all infestations
1.71 to 6.20	Undetectable for "static" infestations Light for "increasing" infestations
9.30 to 31	Light for "static" infestations Moderate for "increasing" infestations
34.10	Moderate for "static" infestations Heavy for "increasing" infestations

[a]Number of egg masses per square meter of foliage.
[b]Defoliation class limits (percent of new growth).
Undetectable = <5 percent
Light = 5 to 35 percent
Moderate = 35 to 65 percent
Heavy = >65 percent

These predicted defoliation classes have been proven accurate during the "increasing" phase of an outbreak. However, during the "static" or "decreasing" phase of an outbreak, predictions may be subject to error.

RESULTS

The Forest and other lands have been divided into entomological units which generally conform with analysis units described in the DEIS, Western Spruce Budworm Management Program, Santa Fe National Forest, issued in April 1983. Future use of the term analysis unit refers to this document. An entomological unit can be described as an area of land on which a particular management action has a reasonable chance of being effective and easily administered.

Based on aerial survey data, the infestation increased from 118,000 acres in 1983 to over 266,000 acres in 1984. Egg mass survey results and defoliation predictions by entomological unit are described in the following paragraphs. These survey results are summarized in table 2.

Jemez East Entomological Unit. This unit consists of portions of the Jemez, Espanola, and Tesuque Ranger Districts, and Santa Clara Pueblo Indian Reservation. The entomological unit is the combined Los Alamos and Peralta analysis units in the DEIS (figure 1). Egg mass densities increased from 22.2 per meter square foliage in 1983 to 33.1 per meter square foliage in 1984. Defoliation increased dramatically from 25,200 acres in 1983 to 71,825 acres in 1984. During 1985, defoliation is expected to occur at moderate levels.

TABLE 2.--Results of the 1984 egg mass survey by entomological units

Entomological unit	1984 defoliation[1] (acres)	Number sample plots	Egg mass densities[2] (S.E.)	Trend	1985 defoliation prediction[4]
Jemez East	71,825	15	33.1 (5.3)	Increasing	Moderate
Jemez West	121,700	16	21.8 (4.1)	Static	Light/moderate
Jemez Spray	33,000	10	13.3 (3.4)	Static	Light
Jemez North	14,545	10	10.9 (3.7)	Decreasing	Light
Mesas	5,875	10	5.3 (1.9)	Static	Undetectable
Mud Springs	0	10	1.8 (0.7)	N.D.	Undetectable
Cow Creek	0	10	0.6 (0.4)	N.D.	Undetectable
Pecos	2,750	10	3.1 (2.1)	N.D.	Light
Tesuque	1,950	N.D.[3]	N.D.	N.D.	N.D.

[1]As detected aerially.
[2]Expressed as egg masses per meter square foliage.
[3]No data.
[4]Percent of new growth defoliated: Undetectable, <5; light, 5-35; moderate, 35-65; heavy, >65

Jemez West Entomological Unit. This unit consists of the Rio de las Vacas and San Pedros analysis unit from the DEIS. The unit encompasses portions of the Jemez, Coyote, and Cuba Ranger Districts. Egg mass densities decreased slightly from 1983 levels; 29.2 in 1983 versus 21.8 in 1984 egg masses per meter square foliage. Again, the extent of defoliation increased from 62,150 acres in 1983 to 121,700 acres in 1984 (figure 2). Defoliation intensity in 1985 is expected at light to moderate levels.

Jemez Spray Entomological Unit. This unit consists of portions of the Cuba Ranger District and Jemez Pueblo Indian Reservation (figure 3). In the DEIS, this unit is part of the Rio de las Vacas analysis unit. The Jemez Spray unit was treated with carbaryl in 1977 as part of a pilot suppression project (Parker et al. 1980). Egg mass densities decreased slightly from 1983 levels; 20.6 in 1983 versus 13.3 in 1984 egg masses per meter square foliage. Defoliated acreage increased to 33,000 acres during 1984. Defoliation is predicted to be light in the unit during 1985.

Jemez North Entomological Unit. This unit consists of portions of the Espanola Ranger District and is basically the same as the DEIS Abiquiu analysis unit (figure 4). Egg mass densities decreased from 24.8 in 1983 to 10.9 egg masses per meter square foliage in 1984. Defoliation increased to 14,545 acres during 1984. Light defoliation is predicted during 1985.

Mesas Entomological Unit. The unit boundaries are identical to those described in the DEIS (figure 5). Egg mass densities decreased slightly during 1984; 1983 estimates were 8.3 egg mass per meter square foliage compared to 5.3 in 1984. However, defoliation increased substantially during 1984 to 5,875 acres. Based on egg mass densities, light defoliation is predicted for 1985.

Mud Springs Entomological Unit. This unit has the identical boundaries as the DEIS Mesas analysis unit. Egg mass densities were estimated at 1.8 egg mass per meter square foliage during 1984. No egg mass data were collected during previous years. No defoliation was apparent during aerial surveys. Undetectable levels of defoliation are predicted for 1985.

Cow Creek Entomological Unit. This unit is identical to the DEIS Cow Creek analysis unit (figure 6). Egg mass densities were estimated at 0.6 egg masses per meter square foliage for 1984. Egg mass data were not collected during previous years. No defoliation was visible during aerial surveys. Undetectable defolation levels are predicted for 1985.

Pecos Entomological Unit. This unit is identical to the DEIS Pecos analysis unit (figure 6). This was the first year an egg mass survey was conducted in this unit. Egg mass densities were estimated at 3.1 per meter square foliage. Defoliation was estimated at 2,750 acres for 1984. Light defoliation is predicted during 1985.

Defoliation was detected aerially for the first time in recent years during 1984. Ground examinations in both Dalton and Holy Ghost Canyons revealed only sporadic light defoliation.

Tesuque Entomological Unit. This unit is identical to the DEIS Tesuque analysis unit (figure 7). During 1984, defoliation visible from the air was estimated at 1,950 acres. Again, this is the first reported defoliation during recent years. Egg mass surveys were not conducted in this unit. However, ground examinations in the Black Canyon Campground and Hyde State Park area confirmed light defoliation in the mixed confier type.

MANAGEMENT ALTERNATIVES

Budworm management alternatives and the environmental effects of each alternative, along with discussions on the affected environment, are described in detail in the Western Spruce Budworm Management Program, Santa Fe National Forest, DEIS and by Telfer (1983). The alternatives are summarized as follows:

Alternative 1 - No Action.

Alternative 2 - Silvicultural Management.

Alternative 3 - Direct Suppression of Infested Analysis Unit and Other Infested Land Ownerships with a Combination of Insecticides.

Alternative 4 - Direct Suppression with Bacillus thuringiensis (B.t.) on All Infested Lands.

Alternative 5 - Direct Suppression of Localized Areas of High Interest

Alternative 6 - Proposed Action, a Combination of Approaches as follows:

1. Santa Fe National Forest. No Action is proposed for noncommerical timberlands, except for the Mesas, Mud Springs, and Cow Creek units. Silvicultural Management is proposed for all commerical timber stands within all host-type areas. Direct Suppression of Infested Analysis Units with a Combination of Insecticides is proposed on the Mesas, Mud Springs, and Cow Creek analysis units should a significant infestation develop.

2. Jemez Pueblo Indian Reservation. Direct Suppression with a Combination of Insecticides is proposed on host-type lands.

3. Santa Clara Pueblo Indian Reservation. Direct Suppression with B.t. is proposed on host-type lands.

Insecticides registered for use against the western spruce budworm are:

1. Carbaryl (carbamate insecticide). The Sevin 4 oil formulation of carbaryl has given satisfactory results in suppressing budworm outbreaks throughout the West. A portion of the Santa Fe National Forest was successfully treated in 1977, and tree damages have remained at low levels for over 5 years (Telfer 1984). Carbaryl is a nonpersistent pesticide which is available for general use. One pound of active ingredient per acre is the registered dosage rate, and no lasting environmental effects have been identified at this application rate.

2. Acephate (organophosphate insecticide). Orthene Forest Spray (acephate) is a nonpersistent insecticide registered for use against the western spruce budworm and other forest defoliators. Although this insecticide has been shown to be effective against the budworm, it has never been used in the Southwest. Without further pilot testing in the Southwest, it is not recommended.

3. Mexacarbate (carbamate insecticide). Mexacarbate (Zectran) is a nonpersistent pesticide which is available for use against the western spruce budworm. Mexacarbate is applied at a rate of 0.15 pounds of active ingredient per acre. Mexacarbate has never been used against the western spruce budworm in the Southwest; pilot testing the efficacy of this insecticide is recommended before operational use.

4. Bacillus thuringiensis (microbial insecticide). Bacillus thuringiensis, a bacterium, has been used experimentally and operationally in the Southwest. Results have been somewhat variable. However, the B.t. formulations used against the western spruce budworm are nontoxic to most organisms other than the larval stages of insects belonging to the order Lepidoptera. Its use is particularly appropriate in sensitive environments where the environmental risk associated with chemical insecticides is unacceptable.

RECOMMENDATIONS

Management of the Current Western Spruce Budworm Outbreak. For 1985, direct suppression (alternatives 3, 4, or 5 in the DEIS) is not recommended in any entomological or analysis unit. Again, the various environmental consequences and management alternatives for the current outbreak are described in detail in the DEIS. While budworm populations appear to be increasing in the Mesas, Cow Creek, Pecos, and Tesuque entomological units, the extent and intensity does not warrant direct suppression action. Forest Pest Management will continue to monitor budworm populations in the areas during 1985.

For the Jemez Pueblo and Santa Clara Pueblo Indian Reservations, direct suppression is not recommended during 1985. Infestations on these lands and adjoining Santa Fe National Forest lands have existed for several years. During this period, western spruce budworm population densities have generally been high. Thus, the biological effectiveness of a direct suppression program in these areas appears questionable at this time.

Western spruce budworm damage has a negative impact on scenic beauty and/or esthetic values. At times, various publics perceive this damage as severe. Actions can be taken to prevent serious degradation of these values in high-use areas (i.e., alternative 5 in the DEIS). However, locating areas where scenic beauty values warrant protection and determining a damage threshold level to trigger management action are difficult tasks. Forest Pest Management recommends consideration be given to potential western spruce budworm impacts to the scenic beauty/esthetic resource. While this task is best addressed at the Forest level, Forest Pest Management can provide assistance.

Tree damages resulting from the current western spruce budworm outbreaks are apparent and likely to increase in severity. Where appropriate, salvage sales are recommended to capture, at least partially, these losses. Fuelwood sales may also be appropriate, particularly if sawtimber markets are nonexistent.

Management of Mixed Conifer Forests to Minimize Impacts From Future Western Spruce Budworm Outbreaks. The western spruce budworm is a long-term forest management problem and is being addressed in the proposed Forest Plan. The recommended management approach is silvicultural strategies which reduce stand susceptibility/ vulnerability. Specifically, silvicultural prescriptions should stress "state-of-the-art" stand management. These strategies should include, but are not limited to: (1) Intermediate cuttings, such as commerical or precommerical thinning and sanitation/salvage, to increase stand vigor, regulate stocking, and favor nonhost tree species; (2) regeneration cuttings using the clearcut and shelterwood methods designed to create a mosaic of more even-aged stands, with a lower percentage of true fir; and (3) artifical regeneration with nonhost tree species.

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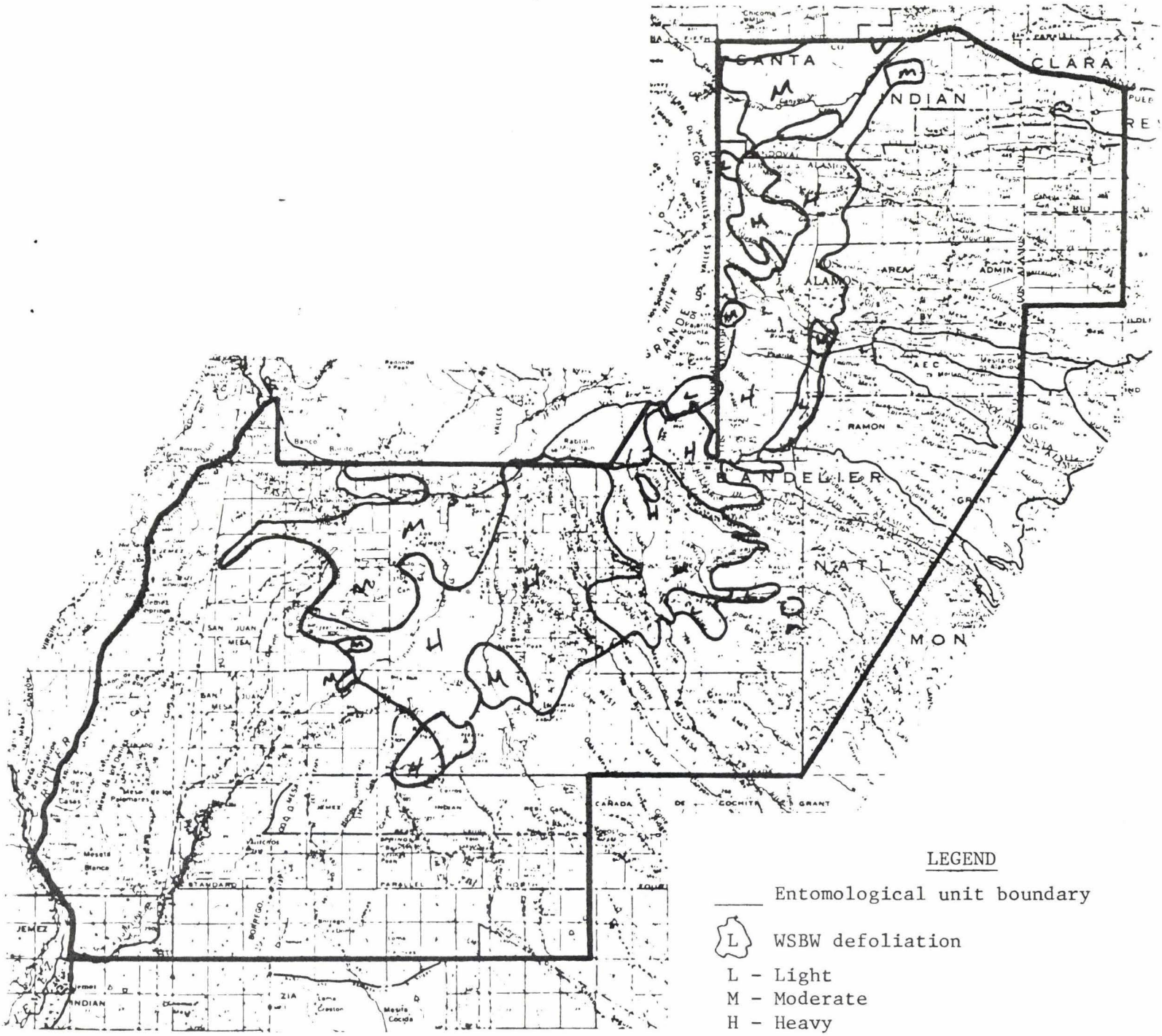

FIGURE 1.--Defoliation on the Jemez East entomological unit, 1984

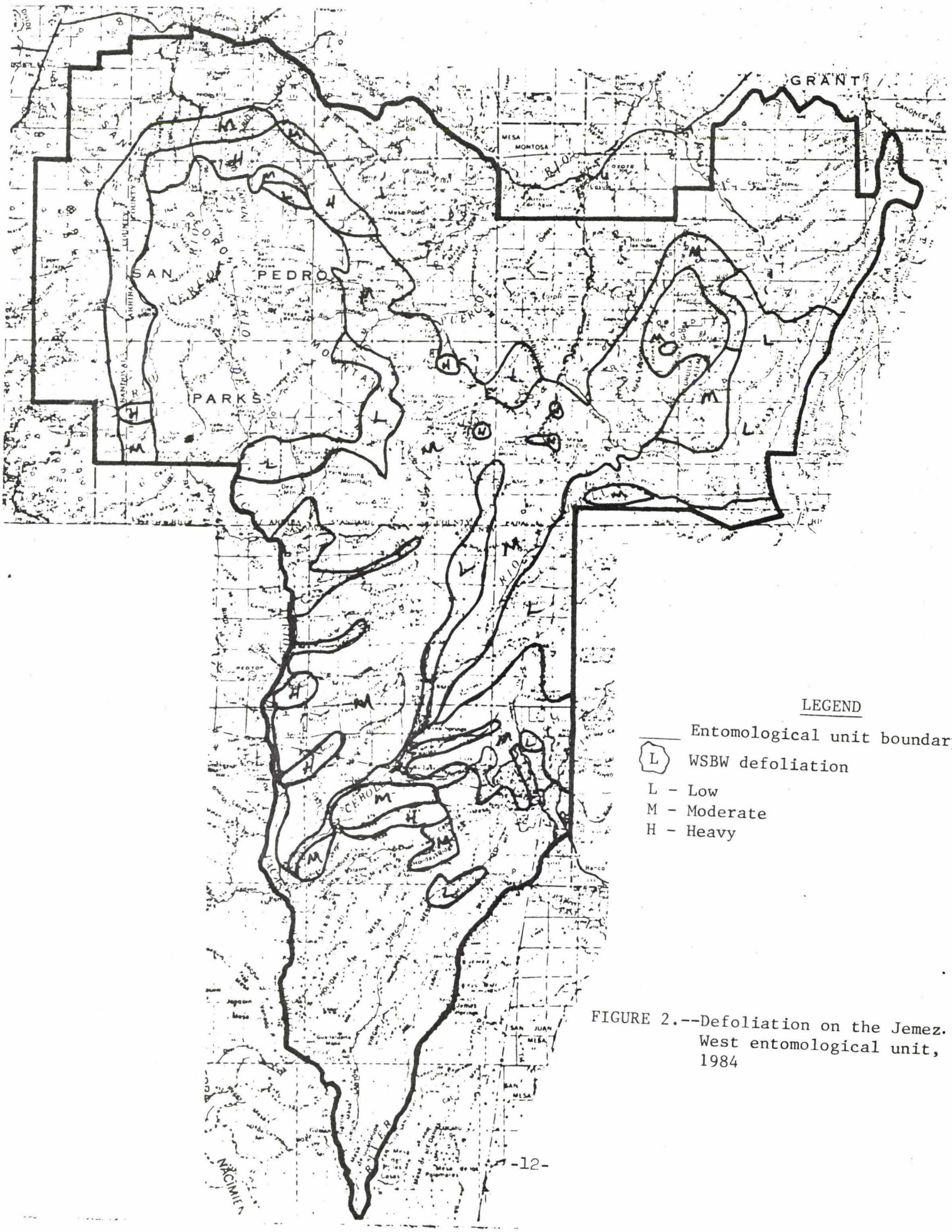

FIGURE 2.--Defoliation on the Jemez. West entomological unit, 1984

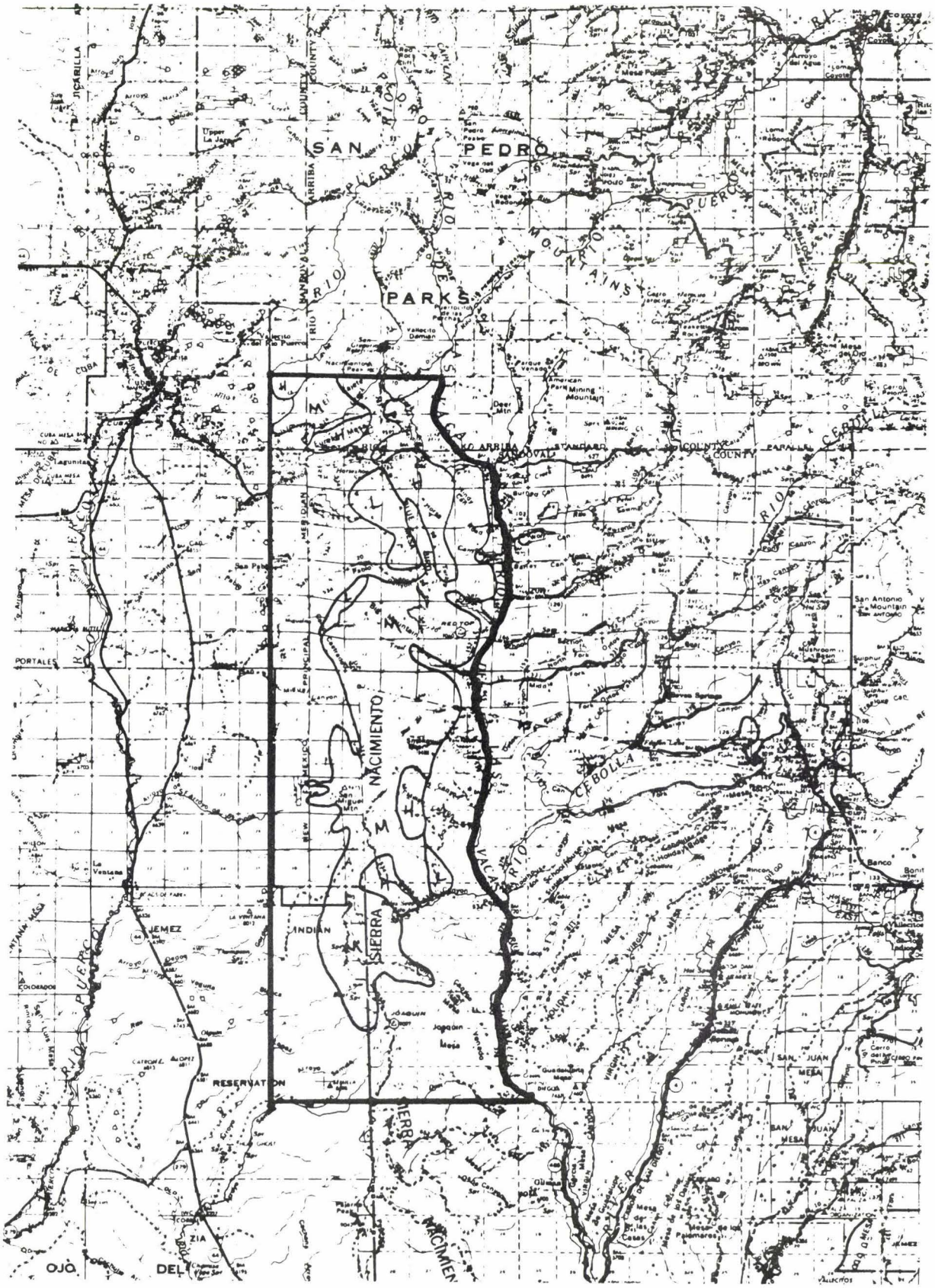

FIGURE 3.--Defoliation on the Jemez Spray entomological unit, 1984

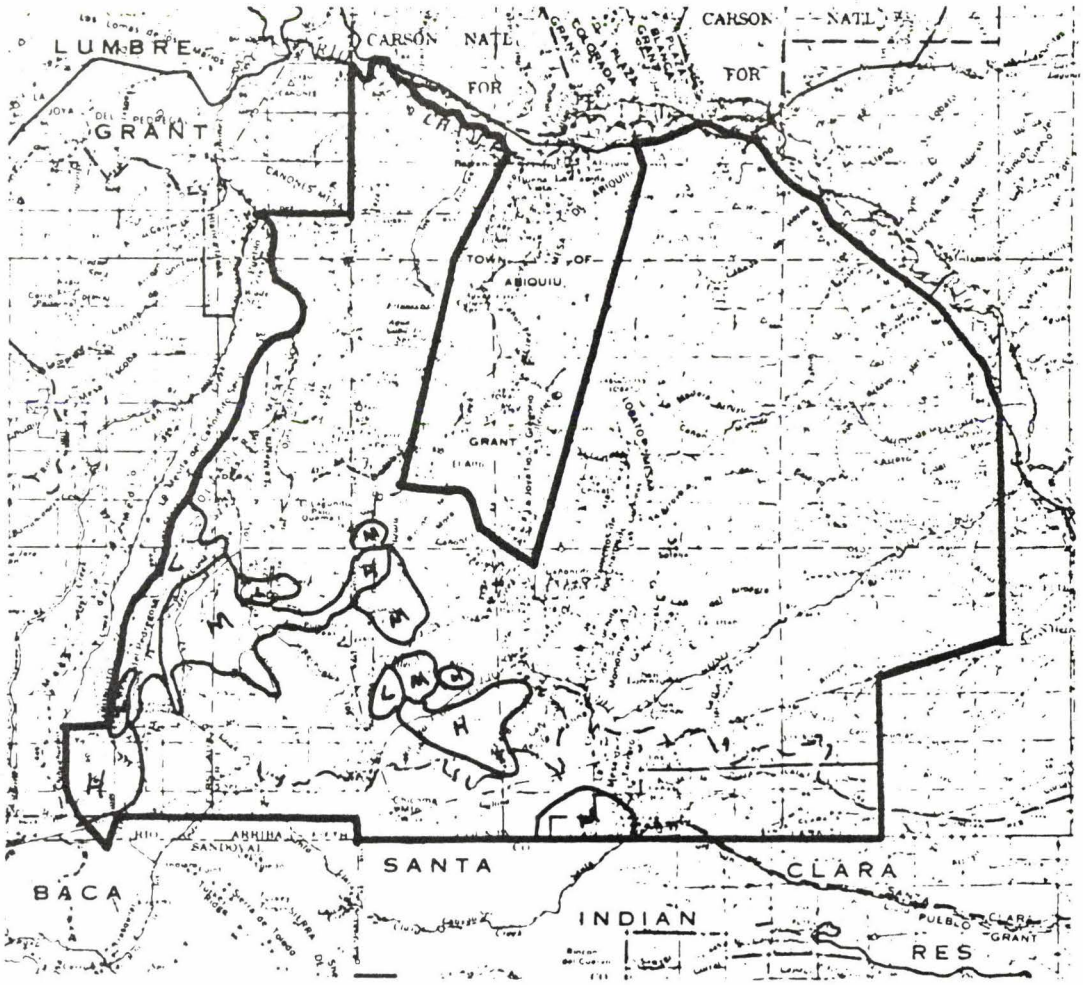

FIGURE 4.--Defoliation on the Jemez North entomological unit, 1984

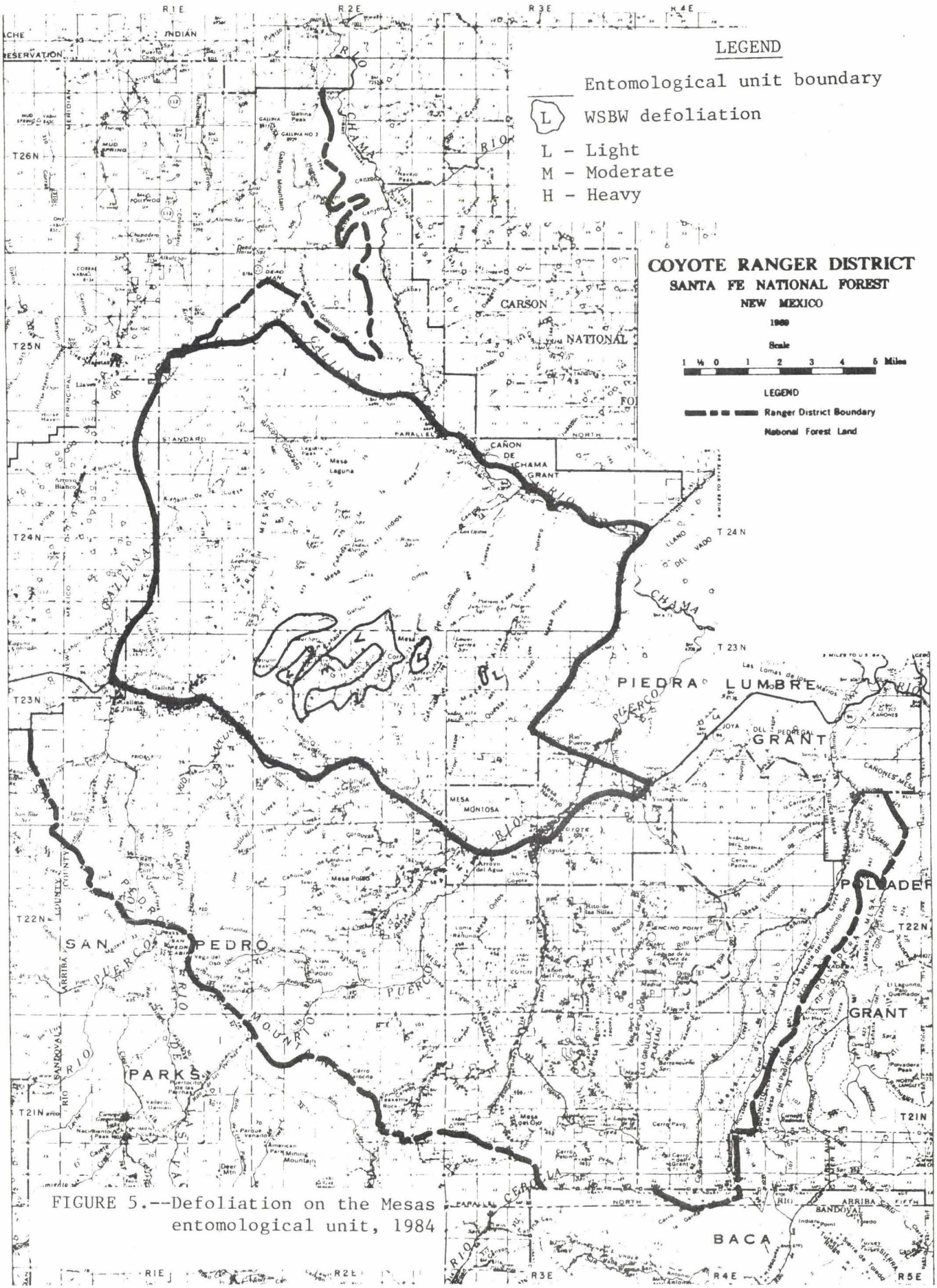

FIGURE 5.--Defoliation on the Mesas entomological unit, 1984

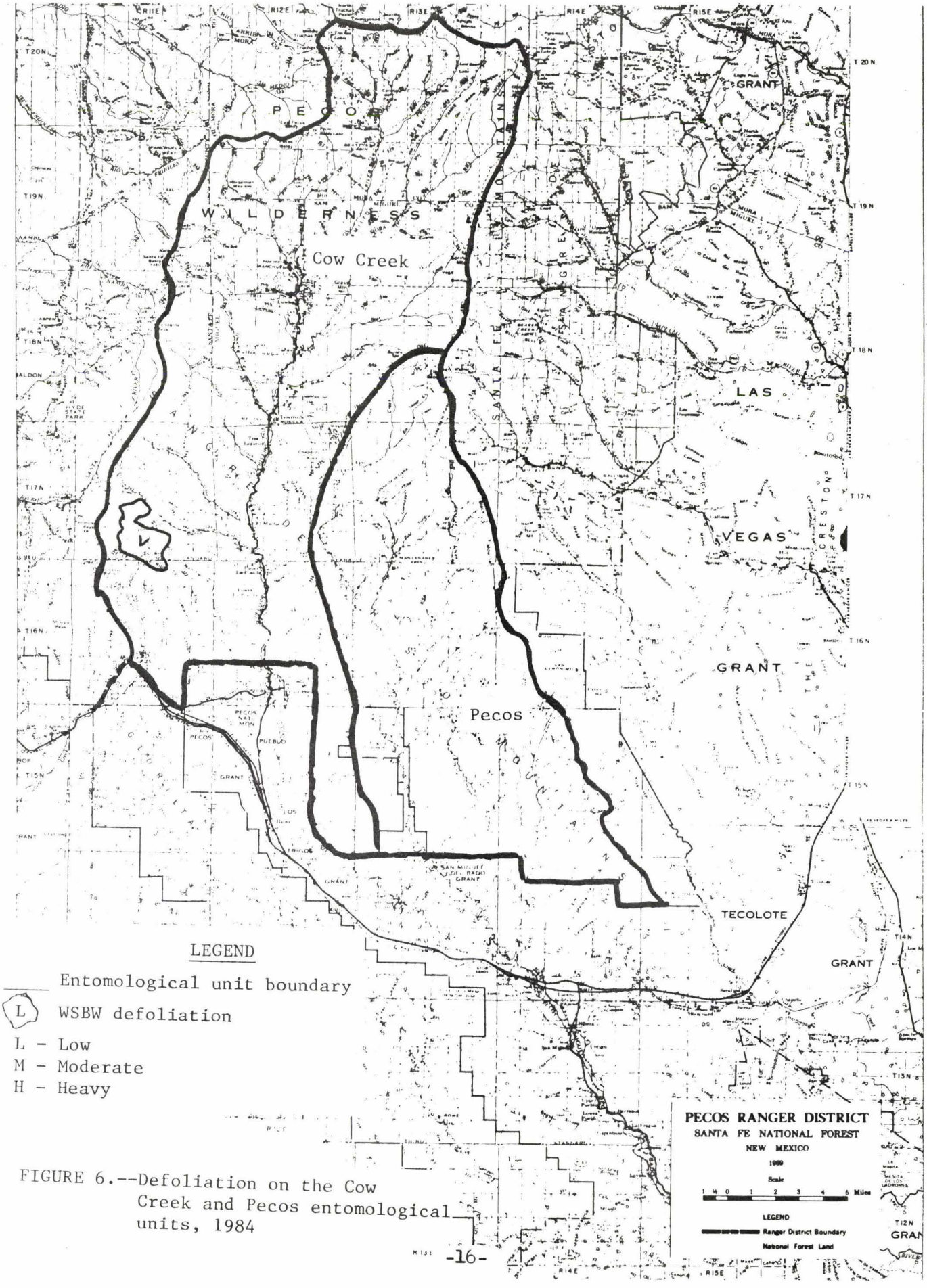

FIGURE 6.--Defoliation on the Cow Creek and Pecos entomological units, 1984

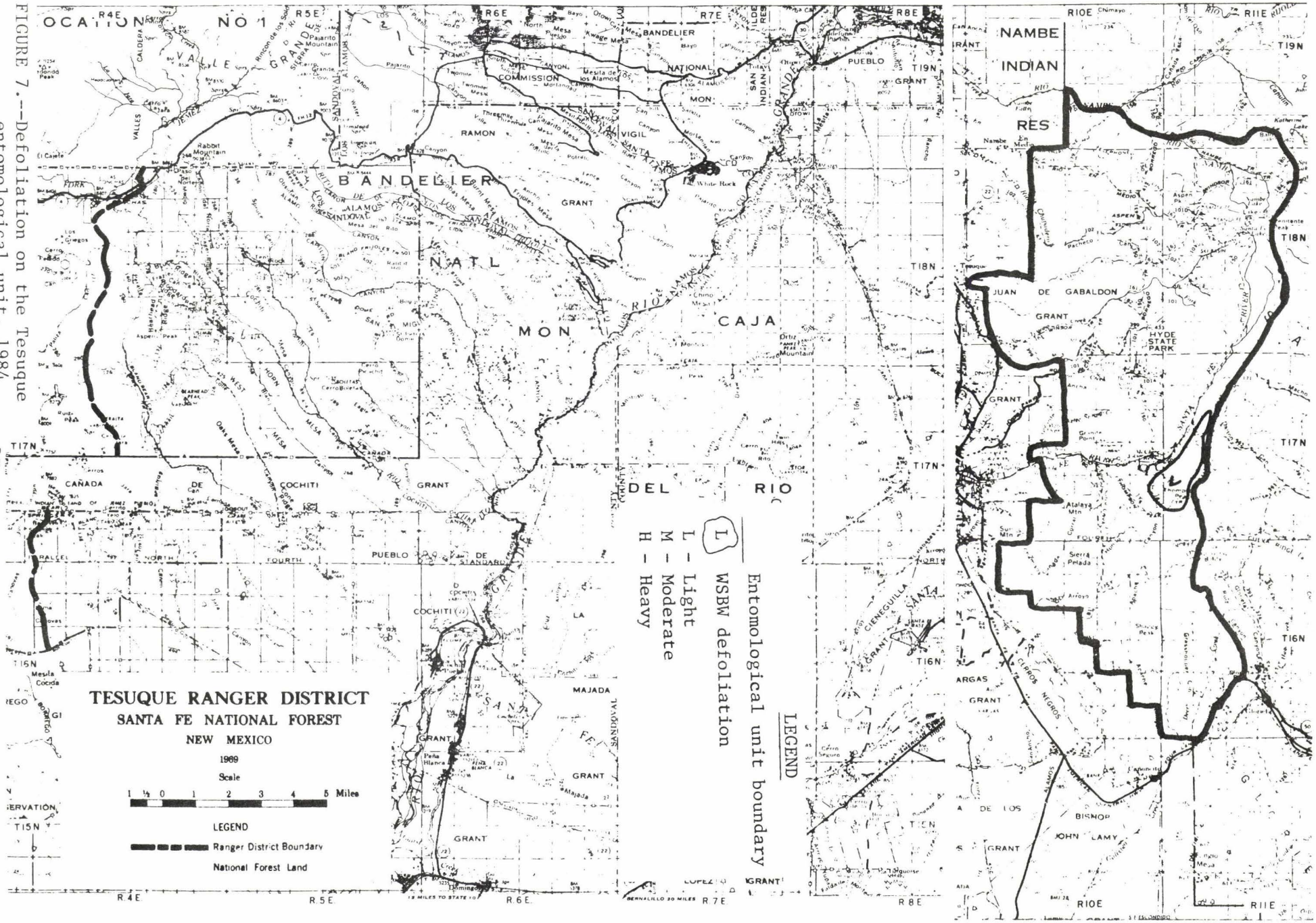

FIGURE 7.--Defoliation on the Tesuque entomological unit, 1984